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Generation of coherent spin-wave modes in yttrium iron garnet microdiscs by spin-orbit torque

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Abstract

In recent years, spin-orbit effects have been widely used to produce and detect spin currents in spintronic devices. The peculiar symmetry of the spin Hall effect allows creation of a spin accumulation at the interface between a metal with strong spin-orbit interaction and a magnetic insulator, which can lead to a net pure spin current flowing from the metal into the insulator. This spin current applies a torque on the magnetization, which can eventually be driven into steady motion. Tailoring this experiment on extended films has proven to be elusive, probably due to mode competition. This requires the reduction of both the thickness and lateral size to reach full damping compensation. Here we show clear evidence of coherent spin-orbit torque-induced auto-oscillation in micron-sized yttrium iron garnet discs of thickness 20 nm. Our results emphasize the key role of quasi-degenerate spin-wave modes, which increase the threshold current.

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